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भाग 2 मोटरयुक्त

(पहला पुनरीक्षण)

Indian Standard

ELECTRICAL TIMER RELAYS FOR INDUSTRIAL PURPOSES—SPECIFICATION

PART 2 MOTORIZED

(First Revision)

UDC 621·318·562·7

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

May 1993 Price Group 3

Power Systems Relay Sectional Committee, ET 35

FOREWORD

This Indian Standard (Part 2) was adopted by the Bureau of Indian Standards, after the draft finalized by the Power System Relays Sectional Committee had been approved by the Electrotechnical Division Council.

This Standard [IS 5834 (Part 2)] is being revised to bring it in line with current practices in the country. The major changes made are as follows:

a) The timers for operation on dc power supply have been excluded as it required cumbersome design for control of constant speed at all voltage ranges marked. The inverter units (changes dc to ac) is recommended when relay is operated on dc supply.

b) The parameters of load circuits of contacts (*see* **9.2**) have been left to be decided between the manufacturer and user.

c) Repeat/Resetting time accuracy of the relay has been modified.

Electrical relays for industrial purposes are now being extensively used in various industries for different control and other purposes. A number of industrial relays for such purposes are now being manufactured indigenously in India.

This standard covers electrical timer relays of motorized type. While IS 5834 (Part 1 and Part 3) cover pneumatic type and electronic type timer relays respectively.

Indian Standard

ELECTRICAL TIMER RELAYS FOR INDUSTRIAL PURPOSES — SPECIFICATION

PART 2 MOTORIZED

(*First Revision*)

1 SCOPE

1.1 This standard (Part 2) covers motorized timer relays employed for providing steplessly adjustable time delay to control various types of industrial circuits of nominal system voltage not exceeding 650 V.

2 REFERENCES

The Indian standards listed in Annex A are necessary adjuncts to this standard.

3 TERMINOLOGY

3.0 For the purpose of this standard, the definitions given in IS 1885 (Part 9) : 1986 in addition to the following shall apply .

3.1 Time Delay Relay

A relay whose operation or resetting is intentionally time-delayed. The time delay of the relay may be fixed or adjustable.

3.2 Time Delay Contact

A contact intended to be used for controlling an external circuit and operated by the time delay relay.

3.3 Instantaneous Contact

A contact working in conjunction with and actuated by the relay but operating without international time delay and to control operation of external circuit, or auxiliary device(s).

3.4 Rated Power Consumption

The power absorbed by the circuits of the relay expressed in volt-amperes at rated voltages and rated frequency.

3.5 Cycle of Operation

Complete sequence of events until the starting position is reached.

3.6 Rated Switching Frequency

The number of cycles of operation which a relay can perform per hour under specified conditions.

3.7 Running

The electrically or mechanically effected process causing the delay.

3.8 Over-run

The unintentional continuation of running after cessation of the energizing quantity.

3.9 Type Tests

Tests carried out to prove conformity with the requirements of this specification. They are intended to prove general quality and design of a given type of relay.

3.10 Routine Tests

Tests carried out on each relay to check requirements likely to vary during production.

3.11 On Delay

'On Delay' signifies that the timing period of a time delay relay is initiated upon energization of its coil.

3.12 Off Delay

'Off Delay' signifies that the timing period of a time delay relay is initiated upon de-energization of its coil.

3.13 Repeat Accuracy

The repeat accuracy of time delay relay is one half of the variation between the maximum and minimum observed operating times at any particular setting, divided by the mean of all the observed operating times and the quotient multiplied by 100 and expressed in terms of $\frac{\text{pMs}}{\text{plus}}$ or minus percentage.

It is given by the formula:

Repeat Accuracy

$$= 1/2 \left\{ \frac{(T_1 - T_2)}{\Sigma \frac{T'}{n}} \right\} \times 100 \text{ percent}$$

where

T_1 = maximum operating time in seconds,

T_2 = minimum operating time in seconds,

T' = actual operating time in seconds for each operation, and

n = number of operations.

4. DESIGN AND CONSTRUCTION

4.1 GENERAL

4.1.1 Materials should be suitable for the particular application.

4.1.2 Parts which may require replacement shall be readily accessible and replaceable.

4.2 Enclosure

4.2.1 The relay may be housed in a suitable enclosure. The type of enclosure shall be one of those covered by IS 2147 : 1962.

4.2.2 The extra enclosure, if provided such as control panel or waterproof box shall be so arranged that when it is opened, the terminals are readily accessible. Furthermore, sufficient space shall be left in the interior of the enclosures for the accommodation of external conductors from their point of entry into the enclosure up to the terminals.

4.2.3 The cover of the protective enclosures shall be so secured to its base that it cannot be accidentally loosened or detached owing to effects of operation of the relay. Also it should be so secured that it is not possible to open it without the use of tools, unless suitable means are provided to prevent accidental contact with live parts.

4.2.4 The enclosure, if metallic, shall be so constructed that, unless marked to the contrary, it may be provided with two suitable earth terminals.

4.3 Terminals

4.3.1 The terminals shall be of adequate size.

4.3.2 Terminal connections shall be such that conductors may be connected by means of screws or other equivalent means so as to ensure that the necessary contact pressure is maintained permanently.

4.4 Contacts

Simultaneous use of normally open and normally closed contact on the same pole shall be permissible only on the same polarity.

4.5 Means of Time Delay Setting

Relay shall be provided with the suitable knob(s) for steplessly adjusting the desired delayed time in conjunction with graduated scale and shall be so arranged that movement of knob in clockwise motion increases delayed time and shall so decrease with anticlockwise motion.

4.6 General Operating Principle

The relay mechanism actuates the contact(s) after the preset operating time has elapsed starting from the time the relay was energized. The contacts remain actuated until the relay is de-energized. If the excitation circuit is prematurely interrupted, the mechanism returns to its initial position before actuating the contacts. However, in case 'No-volt' feature is provided, the relay will not reset to its preset condition in the event power fails before the completion of set delay. In such case, the manufacturer shall specify the feature clearly on the relay.

4.7 Type of Drive

The relay may be operated with ac synchronous motor.

4.8 The relay shall be suitable for operation in ambient temperature of – 5 to + 45 °C.

5 RATINGS

5.1 Rated Motor Circuit Voltage

The rated motor circuit voltage shall be of one of the following values: 24, 48, 110, 240 and 415 V ac

5.2 Rated Contact Circuit Voltage

The rated contact circuit voltage shall be of one of the following values:

For ac systems 110, 240 and 415 V; and

For dc systems 24, 48, 110 and 220 V.

5.3 Rated Current of the Contact

The manufacturer should state the rated continuous current and also VA rating at various power factor that contact are capable of handling.

5.4 Rated Time Setting Range

The rated time setting range of the relay shall be stated by the manufacturer.

5.5 Rated Frequency

The rated frequency shall be the standard frequency of 50 Hz.

5.6 Rated Resetting Time

The manufacturer should state the rated resetting time of the timer.

5.7 Rated Making and Breaking Capacity

The manufacturer should state the rated making and breaking capacities.

5.8 Rated Switching Frequency

The rated switching frequency of the relay shall not be less than 1 000 operation per hour.

5.9 Mechanical Endurance

The relay shall be capable of operating atleast 10^6 operations at rated switching frequency.

5.10 Electrical Endurance

The relay shall be capable of withstanding atleast 0.05 x 10^6 operations at a specified VA rating of contacts (*see* **5.7**).

5.11 Limits of Temperature-rise

The maximum temperature-rise of the various parts, when tested under the rated conditions and in accordance with Annex B, shall not exceed values given in Table 1 over a reference ambient temperature of 40°C.

Table 1 Limits of Temperature-Rise for Relay Parts

Sl No.	Material and Description of the Part	Temperature-Rise in °C
(1)	(2)	(3)
i)	Contacts	65
ii)	Terminals	45
iii)	Metallic parts acting as springs	The temperature shall not reach a value where the elasticity of the materials is impaired.

5.11.1 The temperature-rise of insulated coil in the relay shall not exceed the temperature-rise limits specified in Table 2 when checked by the variation of resistance method over a reference ambient temperature of 40°C.

Table 2 Temperature-Rise Limits for Insulated Coils for Motor Winding

(*Clause* 5.11.1)

Class of Insulation	Temperature-Rise Limit in °C
Class A	65
Class E	80
Class B	90
Class F	115
Class H	140

NOTE– The thermal classification of insulation is that given in IS 1271:1985.

6 OPERATING CHARACTERISTICS AND LIMITS OF ERROR

6.1 The relay shall be capable of operating satisfactorily at any voltage between 85 to 110 percent of rated voltage and at any frequency between 95 to 105 percent of the rated frequency.

6.2 Limits of Error

6.2.1 *Setting Accuracy*

The variation in actual operating time and set time at constant frequency shall not exceed ± 6 percent of the full scale with the permissible voltage range of ± 6 percent.

6.2.2 *Repeat Accuracy*

The relay shall maintain its repeat accuracy at all value of between 85 to 110 percent of rated voltage and at constant frequency within ± 2 percent.

7 NORMAL SERVICE CONDITIONS

7.1 Unless otherwise stated, the relays shall be suitable for use under the following service conditions:

a) Reference ambient temperature for temperature-rise measurement 40°C
b) Maximum ambient air temperature 45°C
c) Maximum daily average ambient air temperature 35°C
d) Maximum yearly average ambient air temperature 30°C
e) Altitude up to 1 000 m above sea level
f) Atmospheres which are not heavily polluted
g) For installations reasonably free from vibration and when installed with an angle of inclination as specified by the manufacturer.

8 MARKING

8.1 The following information shall be distinctly and legibly marked on every relay:

a) Reference to this Indian Standard;
b) Indicating the source of manufacture, type, and designation;
c) Rated time setting range;
d) Rated motor circuit voltage;
e) Rated contact circuit voltage;
f) Rated continuous current of the contact; and
g) Rated frequency.

8.2 The relay may also be marked with the BIS standard certification mark.

9 TESTS

9.0 Tests are classified into two classes, namely, type tests and routine tests, as in **9.0.1** and **9.0.2.**

9.0.1 Type Tests

The following shall comprise type tests:

a) Temperature-rise test on contacts and terminals (**9.1**),
b) Temperature-rise test on coil (**9.1**),
c) Verification of rated making and breaking capacities and mechanical endurance (**9.2**),
d) Verification of limits of operation (**9.3**),
e) Verification of resetting time (**9.4**),
f) High voltage test (**9.5**), and
g) Vibration test (**9.6**).

9.0.2 *Routine tests*

The following shall comprise routine tests:

a) Verification of limits of operation (**9.3**) and
b) High voltage test (**9.5**).

9.1 Temperature-rise Test

9.1.0 *General*

Annex B gives the methods of measurement of temperature and precautions to be observed while carrying out the temperature-rise measurements. For conductors other than windings, the temperature of different parts shall be measured by means of thermometers and/or thermocouples at the nearest accessible portion of the hottest accessible spot.

9.1.1 *Ambient Temperature*

The amient temperature shall be measured during the last quarter of the test period by means of at least three thermometers equally distributed around the relay at about half its height and at a distance about one metre from the relay. The thermometers shall be protected against air currents and heat radiation.

9.1.2 *Temperature-rise Test for Contacts and Terminal*

This test shall be made on a new relay with clean contacts. However, it shall be permissible, before beginning the test, to operate the relay a few times with or without load.

9.1.2.1 The relay shall be mounted approximately as under usual service conditions and shall be protected against undue external heating or cooling.

9.1.2.2 Temporary connections to the terminals shall be such that no abnormal amount of heat is conducted away from the relay during tests. Unless otherwise agreed to between the manufacturer and the user, the type and cross-section of temporary connections shall be as specified by the manufacturer and particulars recorded in the test report.

9.1.2.3 The temperature-rise test on the contacts and terminals shall be made at the rated current. The test shall be made for a sufficient time for the temperature-rise to reach a constant value, but not exceeding 8 hours. In practice, this condition is reached when the variation does not exceed one centigrade degree per hour. Thermal equilibrium shall also be reached for the relay coil.

9.1.3 *Temperature-rise Test for Relay Coil*

The coil shall be tested with corresponding rated current flowing through the coil for the duration of the test. The temperature shall be measured when thermal equilibrium is reached in both coils and contact circuits (*see* **9.1.2**)

9.2 Verification of Rated Making and Breaking Capacities and Mechanical Endurance

9.2.1 The tests are meant to verify that the relay contacts are capable of making and breaking the current as specified in **5.7** and **5.9.**

9.2.2 *Test Circuit*

The power supply used for verification for rated making and breaking capacities shall have adequate capacity to permit verification of the characteristics declared in **5.7.**

9.2.2.1 The test circuit may consist of either motor or air cored reactors in series with the resistors. The resistance and reactance of the circuit may be adjustable to suit the specified set conditions given in **9.2.1.**

9.2.3 The test shall be applied for 0.5 x 10^6 times at the rated switching frequency. During the test the routine maintenance instructions, recommended by the manufacturer may be carried out. The relays would have passed the test if the contacts are not worn out and the mechanical movements of the relay are satisfactory.

9.3 Verification of Limits of Operation

The operating time of the relays shall be tested at the two extreme values of its time setting range and one intermediate value. The value of the operating time shall not differ from the setting by more than ± 6 percent.

9.4 Verification of Resetting Time

The time taken by the relay to return to its inoperated position from its operated position by sudden removal of the characteristic quantity shall be determined. The resetting time (**5.6**) shall not be more than 0.3 second.

9.5 High Voltage Test

9.5.1 High voltage test shall be made on a new relay mounted as under service conditions including internal wiring, if any and in a clean and dry condition.

9.5.1.1 When the cover of the relay is of insulation material metallic parts shall be placed at all the fixing points in accordance with the conditions of normal installation of the relay and these parts shall be considered as part of the cover of the relay. When the relay is in an insulating enclosure, the latter shall be covered by a metal foil connected to the frame.

9.5.2 *Application of the Test Voltage*

The test voltage shall be applied for one minute as follows:

a) With the relay in operative condition:
   i) Between all live parts of all poles connected together and the frame of the relay,
   ii) Between each pole and all other poles connected to the frame of the relay, and
   iii) Between the terminals of one side and the terminals of the other side.

b) With relay in inoperative position:
   i) Between all live parts of all poles connected together and the frame of the relay, and
   ii) Between all terminals of one side connected together and the terminals of the other side connected together.

9.5.3 *Value of the Test Voltage*

The test voltage shall have a practically sinusoidal waveform and a frequency between 40 to 60 Hz. Unless otherwise specified, the value of the dry one minute test voltage shall be as follows:

Rated Contact Circuit Voltage volts	*Test Voltage* volts ac (rms)
Up to and including 60	1 000
61 to 300	2 000
301 to 660	2 500

9.6 Vibration Test

The severity of test should be declared by the manufacturer.

ANNEX A

(*Clause* 2.1)

IS No	*Title*
1271 : 1985	Thermal evaluation and classification of electrical insulation (*first revision*)
1885 (Part 9) : 1986	Electrotechnical vocabulary : Part 9 Electrical relays (*first revision*)
2147 : 1962	Degrees of protection provided by enclosures for low voltage switchgear and controlgear

ANNEX B

(*Clauses* 5.11 *and* 9.10)

MEASUREMENT OF TEMPERATURE

B-0 RECOGNISED METHODS OF MEASURING THE TEMPERATURE

B-0.1 The following three methods of measuring temperature are recognised:

a) Thermometer method,
b) Termocouple method, and
c) Self-resistance method.

B-1 THERMOMETER METHOD

B-1.1 Three type of thermometers namely, bulb thermometers containing mercury or alcohol and resistance thermometer may be employed.

B-1.2 When bulb thermometers are used in places where there is any varying or moving magnetic field, those containing alcohol should be employed in preference to those containing mercury in which eddy current may produce sufficient heat to yield misleading results.

B-1.3 When a thermometer is used to measure the temperature of a surface, such that of a coil, the bulb shall be surrounded by a single wrapping of tin foil having a thickness of not less than 0.095 mm. The foil shall be turned up at the end to form a complete covering for the bulb and shall then be secured in contact with the surface under test. The exposed part of the wrapped bulb shall be completely covered with a pad of heat-insulating material without unduly shielding the test surface from normal cooling.

B-1.4 When a thermometer is used to measure the temperature of a resistor, the bulb shall not be wrapped with the foil.

B-2 THERMOCOUPLE METHOD

B-2.1 The two conductors between which the thermo-electrical effect is produced shall be soldered or welded at both the hot and the cold junctions.

B-2.2 When applied to the surface of the live conductors, the hot junction is covered with insulation and shall be wrapped with tin foil as described for bulb thermometers. The thermocouple circuit should be earthed to minimise the possibility of capacitance currents.

B-2.3 The protecting pad of heat insulating material specified in **B-2.2** shall be employed whether the junction is insulated or not.

B-2.4 The cold junction shall be immersed in oil preferably contained in vacuum flask, the temperature of which is measured by means of a thermometer.

B-2.5 When the thermocouple is used to measure the temperature of a resistor, both the tin foil wrapping and the pad shall be omitted.

B-3 SELF RESISTANCE METHOD

B-3.1 In the self-resistance method, the temperature-rise of winding is determined by the increase in its resistance.

B-3.2 The temperature of the winding, as measured by the thermometer before beginning the test, should not differ from that of the surrounding medium. The initial resistance temperature of the winding shall be measured at that time. For example, for copper, the temperature-rise may be calculated from the following formula:

$$\frac{R_2}{R_1} = \frac{T_2 + K}{T_1 + K}$$

where:

R_2 = Resistance of winding at final temperature,
R_1 = Resistance of winding at initial temperature,
T_2 = Final temperature of winding in degree C
T_1 = Initial temperature of winding in degree C and
K = 234.5 for copper wires, and 225 for aluminum wires.

B-3.3 A simple method giving results only slightly less accurate than those mentioned in **B-3.2**, may be employed for the majority of cases. In this the temperature-rise is calculated on the assumption that it amounts to one celsius degree for every 0 to 4 percent increase in resistance for copper wires.

B-3.4 The formula specified in **B-3.2** and **B-3.3** should only be depended upon over the temperature range of 40° to 100° C as specified for coils and conductors.

B-3.5 Unlike the method described in **B-1** and **B-2** the method depending on self-resistance measures the average temperature-rise of the whole winding as contrasted with the temperature at the whole winding as contrasted with the temperature at the surface or other isolated points.

B-4 MEASUREMENT OF AMBIENT TEMPERATURE

B-4.1 The temperature of the surrounding air shall be measured by means of at least two thermometers so placed as to take account of the maximum and minimum ambient temperatures, and the mean reading shall be used for calculations adopted. Each thermometer shall be immersed in oil contained in a bottle of about half litre capacity completely filled.

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Doc : No. ETD 35 (3169)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Printed at New India Printing Press, Khurja, India